Journal of Economics and Financial Analysis
Type: Double Blind Peer Reviewed Scientific Journal
Printed ISSN: 2521-6627 | Online ISSN: 2521-6619
Publisher: Tripal Publishing House | DOI:10.1991/jefa.v1i2.a6
Journal homepage: www.ojs.tripaledu.com/jefa

Determinants of Industrial Production in Turkey

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Abstract

The necessity of emphasizing the importance of industrial production for the sustainable growth and development of Turkey has been a topic of discussion in political and academia circles. The growth in industrial production (output) depends on the investment in manufacturing sectors and the demand for the products. Along with internal demand, Turkey tries to support its manufacturing base with export (incentives). Manufacturing items occupy the greatest share of products in export sales. The development of manufacturing capabilities of the country is clearly based on the demand from inside and out. The effect of Turkey's export on its industrial production throughout 2000's has been analyzed. For this purpose we developed a VAR model where industrial production index was the dependent variable and export, investment, and interest rate were independent variables. All independent variables were found to be significantly explaining industrial production.

Keywords: *Industrial Production; Investment; Export; Time-series; Casualty Test; Vector Autoregressive (VAR) Model.*

JEL Classification: *C220, E220, F430.*

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1. Introduction

Manufacturing has been the engine of growth and the way developed countries have industrialized. Aiming at competitive advantage of scale economies in manufacturing sectors European countries and US have shifted their manufacturing base to China in recent years which made China a rising world economic power. Industrialization is a fundamental factor that explains the growth of Far East Asians countries. Turkey's growth in the last decade can also be largely attributed to development of manufacturing industry. It is also very possible that troubles of Greece, South Cyprus, and Spain show that services are not enough to support and grow national economies. In their studies McCausland and Theodossıou (2012) show that growth in manufacturing output has more effective role on Gross Domestic Product (GDP) growth (Kaldor's Law), than that of service sector had. Bilgin and Sahbaz (2009) reports a 0.9858 correlation coefficient between GDP and industrial production index (IPI) which clearly shows a great relationship between country's GDP growth and industrial production output. Regarding Turkey, the share of manufacturing exports in total exports did not drop below 90% since 1999 (Zungun and Dilber, 2010).

Due to its importance it is well worth looking into factors that explain manufacturing output volume in Turkey. Before we can evaluate any government's performance on the industrialization and economy or to make policy suggestions we have to understand the factors that impact manufacturing output. Our model includes exports, investments and interest rates as exogenous variables that explain manufacturing output measured by industrial production index (IPI).

Turkey's IPI went up from 2002 to 2014. Turkey's GDP per capita increased from 2002 to 2014 in the same period. Turkey's manufacturing is concentrated on automobile, textile, machinery and food which are mostly labor and resource intensive as opposed to technology and knowledge intensive sectors.

2. Literature Review

The relationship and causality between industrialization and foreign trade have been the topic of several theories and studies. Three of these hypotheses will be briefly discussed. They are export based Industrialization (EBI), import substitution industrialization based on protectionism and Endogenous growth. According to export based industrialization hypothesis an increase in export is the main determinant of economic growth (i.e. industrialization). This is supported by at least three approaches (i.e. theories). According to Ricardo's comparative advantage theory, countries will produce in areas where they have comparative

advantage and therefore only selected industries should be supported by the states. Secondly, exports will lead to economies of scale that result in excess capital to be invested in new machinery and/or technology which in return lead to productivity increases in production (Verdoorn's Law). Thirdly, in order to buy the necessary resources and capital equipment firms will import them by the currency that will be generated by exports (Bilgin and Sahbaz, 2009).

According to import substitution hypothesis a country targets industrialization by manufacturing products that is previously imported. In order to achieve that strategy countries curb imports, protect national industries and discourage internal demand by establishing appropriate currency policies, custom tariffs and import quotas (Sacik, 2009). Furthermore state investments, monetary and social policies are adjusted to support import substitution strategy. Several countries including South Korea, China and Turkey employed import substitution. Where South Korea and China moved away from import substitution towards export led growth, Turkey expanded its production base to include capital equipment and semi-finished materials. Despite its efforts, because import substitution strategy was not successfully managed, Turkey still has a major trade deficit partially due to semi-finished goods import. Ironically import substitution strategy has been criticized for high imports of raw materials and more expensive semi-finished goods due to their requirements of advanced technologies.

Endogenous growth theory which is one of the neo classical growth theories is built upon the concept that internal advances in technology will increase manufacturing output and thereby exports. Paul Krugman, Paul Romer, Gene Grossman, and Elhanan Helpman are among the economists who contributed to this theory (Sacik, 2009). Endogenous growth model emphasizes knowledge, human capital, R&D, technological advances, and market size. While foreign trade is encouraged, exports are led by internal growth, and hence the direction of causality is one way.

There are studies that found support for one way causality from internal growth towards exports, for the opposite and for bidirectional causality. In fact in all models - including import substitution – foreign trade increases manufacturing output by providing capital for investments, economies of scale, advanced technology spillovers and competitive environment. Therefore once the wheel starts turning (i.e. foreign trade begins) the causality can become circular. While some of these studies analyzing Turkey did not find support for export based growth theory, most of them cover years much earlier than 1980. Yet Turkey's industry strategy took a turn in 1980 by switching to export led growth from import substitution strategy. Zungun and Dilber (2010) showed one-way

directional relationship both from exports to IPI and from manufacturing goods exports to IPI. Similarly Bilgin and Sahbaz (2009) concluded that exports have a great explanatory power over IPI (i.e. taken as a proxy for economic growth) and results support export-led growth of Turkey's economic model. Therefore we included export as an exogenous variable to explain industrial growth (i.e. IPI).

The reason for mixed results in studies covering periods after 1980s could be that export led growth strategy was not successfully applied. Deviation from the strategy, multiple economic crises (1994, 1998, 2000, 2001), political turmoil, high value of TL, and unpreparedness of industries before switching to export based strategy are some of the reasons for this outcome. Today Turkey's imports for semi-finished goods and capital equipment are among the major reasons for trade deficit. In fact Soyyigit (2010) conclude that Turkey's growth is import and not export based.

The second exogenous variable in the model is investments by both private sector and state in the country. The positive affect of investments on manufacturing output is well accepted (Bilgin and Sahbaz 2009). For example Cobb-Douglas production function includes capital (i.e. investments) and employment (i.e. human capital) as inputs to manufacturing (McCausland and Theodossiou 2012). As shown in the theory there is a strong relationship between investments and industrialization. Therefore investments are included in the model as the second exogenous variable to explain industrial growth.

The third explanatory variable in the model is interest rates. In 1990s high interest rates in Turkey curbed companies' appetite for investment and led them to borrow money from foreign sources and buy government bonds (Soyyiğit 2010). It is reasonable to expect a negative effect of high interest rates on production output. High interest rates will also move investors away from stock markets to bank CD's.

2.1. Industrialization in Turkey

Turkey switched to export-led growth model from an import substitution model by the January 24, 1980 resolution. In order to make that shift happen, structural changes were required to take place. Among the first steps were allowing prices determined by the market forces followed by devaluation of Turkish Lira by 32.7% and announcement of daily exchange rates. The export volume has increased, and the shares of industrialized goods in exports have raised (Hepaktan, 2008).

Between 1980 and 1988 fixed capital investments in manufacturing industry have declined. While the average fixed capital investment of public sector during 1980 and 1983 was 20.7%, it dropped to 9.8% in the period 1984-1988. Similarly the average fixed capital investments in the private sector have dropped from 32.6% to 28.6% for the same periods. In 1980s while the public sector focused on infrastructure investments, the private sector shifted to non-export industries such as housing construction. Despite these facts, the average value-added growth rate in or industrialization was 6.6% from 1980 to 1990. However the growth rate was reduced by 4.2% between the years of 1990 and 2000 (Esiyok, 2004, pp.32-36). With the devaluation crisis in February 2001, the increases in exchange and interest rates have negatively affected industrial production (Berberoglu, 2009, p. 35). Therefore the industry growth rate was reduced by -7.5% in 2001. However the recovery was quick and the growth rate was 9.4% in 2002[1].

Total exports have increased quickly after 1980's, i.e. $2.9 billion in 1980, $27.8 billion in 2000, and $35.8 billion in 2002. The role of Customs Agreement between Turkey and European Union that went into effect on January 1, 1996 played on exports cannot be ignored. According to this agreement the custom taxes and non-tariff barriers between Turkey and EU on manufacturing goods have been lifted. These developments have led Turkish manufacturing industry gain competitive advantage and market their products in European markets[2].

The share of manufactured goods in exports increased from 91% ($25.3 billion) in 2000 to 93% ($33.7 billion) in 2002. As a result of growth in economy, imports of capital equipment and semi-finished goods also increased. While total imports in 1980 were 7.5 billion dollars, it quickly reached to $54.5 billion in 2000 and to $51.6 billion in 2002. In 2000, manufactured goods import were over $45 billion making up 82.6% of total imports[3].

[1] T.C. Başbakanlık Devlet Planlama Teşkilatı. "Türkiye Sanayi Politikası (AB Üyeliğine Doğru)." (Accessed December 18, 2013). www.vilayetler.gov.tr/belgeler/SanayiPolitikasi.pdf

[2] Tonus, Ö. (2007). Gümrük Birliği Sonrasında Türkiye'de Dışa Açıklık Ve Sanayileşme. (Accessed September 19, 2013). mpra.ub.uni-muenchen.de/7121/1/MPRA_paper_7121.pdf

[3] Türkiye Ekonomi Bakanlığı. "Dış Ticaret İstatistikleri." (Accessed October 27, 2013). www.ekonomi.gov.tr/index.cfm?sayfa=79192159-19DB-2C7D-3D5AE56731D11E50

Table 1. Share of Manufacturing Industry Exports in Total Exports

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Export	47.25	63.17	73.48	85.54	107.27	132.03	102.14	113.88	134.91	152.46
Industry (Manufacturing)	44.38	59.58	68.81	80.25	101.08	125.19	95.45	105.47	125.96	143.19
Industry/Export	0.94	0.94	0.94	0.94	0.94	0.95	0.93	0.93	0.93	0.94

Source: Republic of Turkey, Ministry of Economics

After 2002 exports continued to increase along with manufacturing production volume. The exports that were 47.2 billion dollars in 2003 reached to 152.5 billion dollars in 2012. Similarly, industrial goods exports also went from 44.4 billion dollars in 2003 to 143.2 billion dollars in 2012. Turkey's total export along with manufactured goods export decreased due to real estate crisis in US which turned out to be a global crisis that hit Turkey as well. Fluctuations in the currency exchange rates, increase in interest rates and decrease in exports caused a major decline in industrial production. Industrial production index (IPI) fell down to -9.9% in 2009 (Dogan, 2013, p.227). Despite this drop at the index, manufactured goods kept its share of exports around 93% during 2000's.

The total imports increased from 69.3 billion dollars in 2003 to 236.6 billion dollars in 2012. Likewise, industrial goods import increased from 55.7 billion dollars to 176.2 billion dollars in 2013. The share of industrial goods in total imports diminished gradually from 80% in 2000s to 75% in 2013[4].

Table 2. Share of Manufacturing Industry Imports in Total Imports

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Import	69.34	97.54	116.77	139.57	170.06	201.96	140.93	185.54	240.84	236.54
Industry (Manufacturing)	55.69	80.45	94.21	110.40	133.94	150.25	111.03	145.37	183.93	176.23
Industry/Import	0.80	0.82	0.81	0.79	0.79	0.74	0.79	0.78	0.76	0.75

Source: Republic of Turkey, Ministry of Economics

Although there is a higher increase in the share of industrial goods in total exports compared to the increase in total imports, an imbalance of trade in

[4] Türkiye Ekonomi Bakanlığı. "Dış Ticaret İstatistikleri." (Accessed October 27, 2013). www.ekonomi.gov.tr/index.cfm?sayfa=79192159-19DB-2C7D-3D5AE56731D11E50

industrial goods continues to exist. This is evidence of Turkey still going through industrialization process and as long as Turkey cannot produce high-tech products its trade imbalance will continue to grow. Therefore it should be a national policy to develop technology and high-tech products and the state should work side by side with the private sector in order to implement it.

In order to reach the goal of 500 billion dollars export volume by 2023, Turkey's need to produce high-tech products has been put forward by many academicians. Manufacturing sector is highly eligible to produce value added products. Turkey's import for machinery and technology, to a certain degree, has been compensated by the exports of industrial goods. Turkish exporter's entrepreneurial efforts to enter Middle East and African markets have been instrumental in growth of manufacturing sector and closing the trade deficit in this sector.

3. Data Set and Method

Although there were many efforts to increase export volume of Turkey, an effective and applicable solution to the current account deficit couldn't have been found. It seems that the elimination of the current account deficit and providing sustainable development are painful and time consuming. It is believed that the increase in export of industrial products triggers the industrial production capacity which provides sustainable development. Therefore this study aims to search the effects of international trade and macro economic variables on the industrial production index of Turkey. The first step is to determine the proper economic variables affecting the industrial production. With this aim, the years between 2000 and 2012 have been analyzed in three-month segments. After collecting data, the effects of the variables on the industrial production index have been examined. E-views 6.0 packet program was used and VAR model was applied for the analysis.

Table 3. Macro Economic Variables Used in the Model

Variables	Code of Variable	Type	Definition
Industrial Production Index	INDUSTRY	Endogenous	Seasonal Adjusted Stationary
Export	EXPORT	Endogenous	Seasonal Adjusted Stationary
Investment	INVEST	Endogenous	Seasonal Adjusted Stationary
Interest Rate	INTEREST	Endogenous	Seasonal Adjusted Stationary

The series in the model have been selected as quarter periods from The Central Bank data warehouse and they include the periods from the first quarter of 2002 (2002Q1) to the last quarter of 2012 (2012Q4). All series that are subject to analysis have been composed of precise periodic values. First, whether the series has a unit root or not was analyzed through Augmented Dickey Fuller and Dickey Puntola tests. Then, by using seasonal dummy the series was deseasonalized. In the third phase, optimal lag values for the model have been determined with information criteria. In the fourth step, relations between series and their directions were detected by Granger causality test. In the fifth phase, VAR (Vector Auto Regressive) model was formed to forecast the relations between industrial production index and export data. Finally relations between variables were analyzed by establishing cause and effect functions.

4. Model Determination and Analyses

4.1. VAR (Vector Auto Regressive) Model

The vector autoregressive (VAR) model has been a popular choice as a description of macroeconomic time-series data because of the VAR model is flexible, easy to estimate, and it usually gives a good fit to macroeconomic data (Juselius, 2006, p.14). Estimates stemmed from VAR models are quite flexible because they can be conditional on the potential future paths of specified variables in the model. The VAR is a model of several endogenous variables together. Each endogenous variable is explained by its and other variables lagged values in the model. Usually there are no exogenous variables in the model (Gujarati, 2004, p.839).

$$Y_{1,t} = \alpha_1 + \sum_{i=1}^{k} \beta_{1j} Y_{1,t-j} + \sum_{j=1}^{k} \delta_{1j} Y_{2,t-j} + \mu_{1t} \quad (1)$$

$$Y_{2,t} = \alpha_2 + \sum_{j=1}^{k} \beta_{2j} Y_{1,t-j} + \sum_{j=1}^{k} \delta_{2j} Y_{2,t-j} + \mu_{2t} \quad (2)$$

In the model, α is constant term, k is lag length, μ is error term.

4.2. Stationarity of the Variables

The variables used in an analysis should have not unit root to have significant results. So the series of the variables are tested for whether they have unit root or not. If so, the series should be eliminated from it. Dickey Fuller (1979) test or its improved version Augmented Dickey Fuller (ADF) is appropriate to determine the unit root. Augmented Dickey Fuller (ADF) test which was formulated below

applied to the variables to determine the stationarity of them (Baltagi, 2008, pp.362–363).

$$\Delta X_t = a + \alpha X_{t-1} + \beta \sum_{i=1}^{m} \Delta X_{t-i} + e_t \quad (3)$$

$$\Delta X_t = a + bt + \alpha X_{t-1} + \beta \sum_{i=1}^{m} \Delta X_{t-i} + e_t \quad (4)$$

Stationarity without a trend is formulated in Equation (3), and stationarity with a trend is formulated in equation (4). Hypothesis in equation (3) and (4) claims that X_t series has a unit root (H_0: α =0, H_0: b =0). If the hypothesis H_0 is rejected than X_t series is stationary if not it has a unit root (Bozkurt, 2007, pp.27–45). The results of ADF unit root test show if they have unit root or not at 1%, 5% and 10% significance levels. If the series have unit root, differences are taken and eliminated from the unit root (Agung, 2009, p.2).

4.3. Causality Test

Granger (1969) causality test is used for determination of the relations between variables and their directions (Gujarati, 2009, pp.699-702).

$$y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i x_{t-i} + \sum_{i=1}^{n} \gamma_i y_{t-i} + u_i \quad (5)$$

$$x_t = \alpha'_0 + \sum_{i=1}^{n} \theta_i y_{t-i} + \sum_{i=1}^{n} \lambda_i x_{t-i} + u_i \quad (6)$$

Equations 5 and 6 are used to find out how the variables x and y affect one another. With the components of x added to the model, it gets clear if x causes changes on the future values of variable y in equation 5. The same is applied for y to find its affects on x in equation 6. It is necessary that the variables x and y should be stationary to have healthy results from the Granger causality test. If the variables are not stationary, a false causality will be observed. The causality which appears as a result of spurious regression is a sign of serial correlation.

Granger causality test has been applied to determine the relations between the variables, their direction and lag period. At the level of 5% lag significance level, while exports and investments affect industrial production index, the interaction between interest rates and industrial production index is in both directions.

Table 4. Pair Wise Granger Causality Test

Null Hypothesis	F-Statistic	Prob.
H_0:Exportlogsa1 does not Granger cause Industrilogsa1	4.63765	0.0374
H_0:Industrilogsa1 does not Granger cause Exportlogsa1	1.08917	0.3029
H_0:Investlogsa1 does not Granger cause Industrilogsa1	4.72026	0.0358
H_0: Industrilogsa1 does not Granger cause Investlogsa1	0.11375	0.7377
H_0: Interestlogsa1 does not Granger cause	13.2670	0.0008
H_0: Industrilogsa1 does not Granger cause	6.80204	0.0126
H_0: Investlogsa1 does not Granger cause Exportlogsa1	2.41946	0.1277
H_0: Exportlogsa1 does not Granger cause Investlogsa1	0.11121	0.7405
H_0: Interestlogsa1 does not Granger cause Exportlogsa1	0.11933	0.7316
H_0: Exportlogsa1 does not Granger cause Interestlogsa1	10.4325	0.0025
H_0: Interestlogsa1 does not Granger cause Investlogsa1	4.17930	0.0475
H_0: Investlogsa1 does not Granger cause Interestlogsa1	1.29883	0.2612

4.4. Lag for VAR Analysis

Each Endogenous variable is explained by its own lagged values and the other endogenous ones. The lengths of lags are determined by the 5 criteria of LR, FPE, AIC, SC, HQ. The Optimum lag length is the minimum period which is determined by the maximum number of criteria. Optimum lag period is 1 up to all criteria except SC.

Table 5. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	235.8451	NA	2.44e-10	-10.78349	-10.61966*	-10.72308
1	263.4953	48.87010*	1.42e-10*	-11.32536*	-10.50620	-11.02328*
2	273.1653	15.29218	1.95e-10	-11.03095	-9.556453	-10.48720
3	286.5921	18.73507	2.32e-10	-10.91126	-8.781439	-10.12585

Notes: * Indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

4.5. Aligning the Variables

Aligning the variables is required for impulse-response functions which are used to specify the reactions of variables to the shocks caused by other variables. In a VAR model variables should be aligned from exogenous to endogenous.

Although the most exogenous variable doesn't react against the shocks stemming from other variables, the most endogenous one reacts against the shocks coming from all variables in the model. Checking the causality relations between the variables Granger Causality test helps how to align them. In Cholesky decomposition, impulse-response functions may change when the variables are aligned differently. In this study, variables are aligned from exogenous to endogenous as follows; export, investment and interest.

4.6. Impulse-Response Functions

Impulse-Response functions show how effective a standard deviation shock seen in one of the random error terms of VAR model findings might be both in the present and future values of endogenous variables. This decides whether the most effective variable could be used as a political tool or not. Cholesky decomposition is one of the common methods used in defining impulse-response coefficients, verticalising errors and diagonalising the acquired variance-covariance matrix (Phillips and Tzavalis, 2007, pp.356-357).

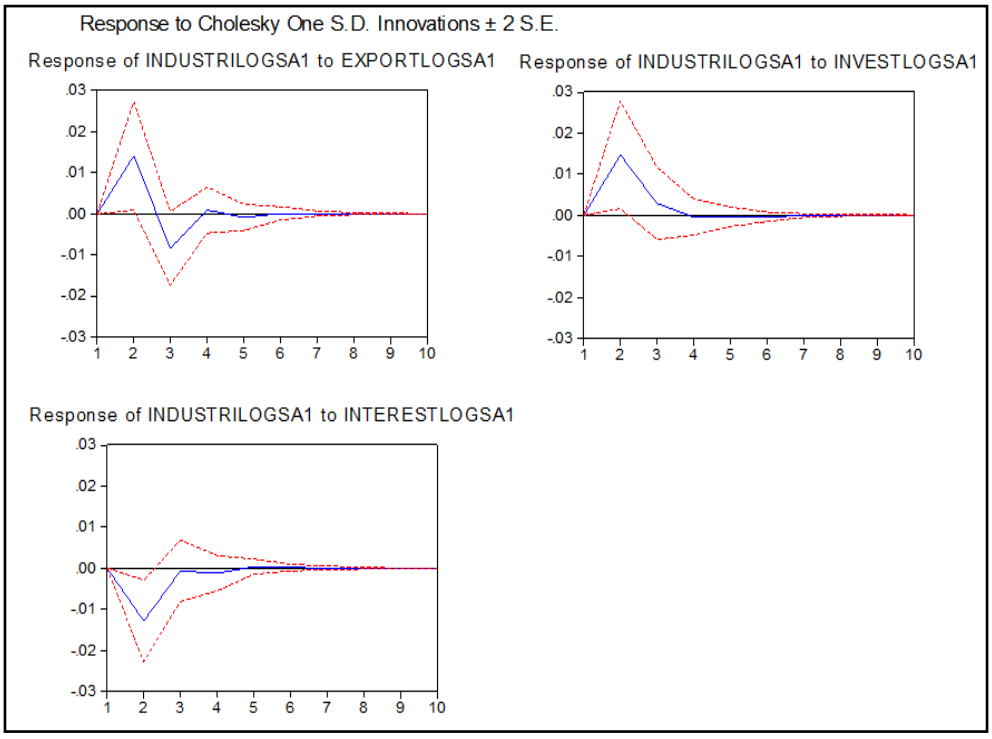

Figure 1. Impulse-Response Function

The first part of Figure 1 shows that the effect of the exports on the industrial production index is positive beginning from the first period to the second one. In the second part, positive effect of the investments on industrial production index can be seen from first period to the second one. And also the negative effect of interest rates on the industrial production index can be seen for the same period.

4.7. Stability Test of VAR Model

Stability should be tested after the model is set up. Stability of the model depends on eigenvalues of coefficient matrix. System gets stationary once all eigenvalues of coefficient matrix exist within unit circle. If the eigenvalues of coefficient matrix are outside the unit circle, then the system is not stationary. All eigenvalues of coefficient matrix stemmed from the model are in the circle unit so the model is stationary.

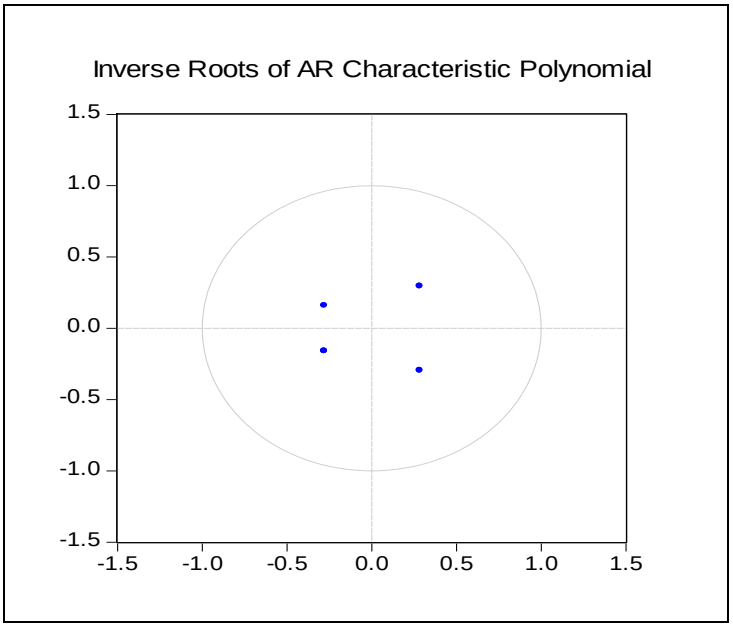

Figure 2. Stability Test of VAR Model

4.8. Autocorrelation Test of VAR Model

Serial Correlation LM Test was used to determine whether the VAR model has a structural problem or not. The test results reveal that there is no autocorrelation between error terms for its 12 lags.

Table 6. VAR Residual Serial Correlation LM Tests

Lags	LM-Stat	Prob	Lags	LM-Stat	Prob
1	14.30639	0.3613	7	15.14915	0.5137
2	14.43202	0.5297	8	10.28045	0.8516
3	18.64128	0.4869	9	22.50441	0.1276
4	16.44244	0.7471	10	19.11127	0.2629
5	10.81115	0.9901	11	17.98662	0.3247
6	12.61664	0.8642	12	15.52702	0.4864

4.9. Heteroscedasticity Test

White heteroscedasticity test was used to determine whether the model has heteroscedasticity problem. The test results show that variance of error term is the same for all observations and there is no heteroscedasticity in the model.

Table 7. Government Debt Stock and White Test for Macro Economic Variables

Chi-sq.	df	Prob.
91.69255	80	0.1749

4.10. Variance Decomposition

Variance decomposition explains how much of the change that occurs in a dependent variable caused from its own past values and how much of it caused from other variables.

Variance decomposition of the model shows that approximately 75.5% of the change in industrial production index for all periods sourced from its own values. The average shares of export, investment, and interest on the industrial production index change are lined as 12%, 10%, and 7.4% respectively.

Table 8. Variance Decomposition

Period	S.E.	Industrilogsa1	Exportlogsa1	Investlogsa1	Interestlogsa1
1	0.039464	100.0000	0.000000	0.000000	0.000000
2	0.046305	72.99032	9.282272	10.07489	7.652515
3	0.047318	70.59506	12.03139	10.02573	7.347815
4	0.047352	70.52826	12.05032	10.02081	7.400611
5	0.047374	70.50676	12.07384	10.01817	7.401230
6	0.047376	70.50071	12.07308	10.02392	7.402290
7	0.047376	70.50030	12.07324	10.02398	7.402479
8	0.047376	70.50031	12.07324	10.02397	7.402480
9	0.047376	70.50030	12.07324	10.02398	7.402481
10	0.047376	70.50029	12.07324	10.02398	7.402482

Cholesky Ordering: Industrilogsa1 Exportlogsa1 Investlogsa1 Interestlogsa1

5. Conclusion

The factors that affected Turkey's industrial production are analyzed in this study. The considerable effects of exports, investments, and interest rates on industrial production have been observed. Our analysis shows that while the effects of exports and investments on industrial production are positive; the effect of interest rate on industrial production is negative. Therefore an increase in export and investments positively impacts industrial production. The fact that majority of exports are industrial goods and the export volume of Turkey has positive effects on industrial production support our findings.

Economic data shows that the most important economic activity in Turkey's development is industrial production. Like many developed countries Turkey should complete industrialization and increase its manufacturing capacity. Increasing manufacturing capacity requires necessary investments and opportunities to export. However insufficiency of national savings to provide enough capital for investments foreign sources of investment becomes essential. Increasing exports depend on products that can compete on a global scale and finding new markets. Therefore both increasing exports and investments are

lengthy processes that require much effort and patience. Nevertheless it is the best choice for a healthy and sustainable development.

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